Realizing Building Energy Modeling's Potential

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NREL SEAC Seminar

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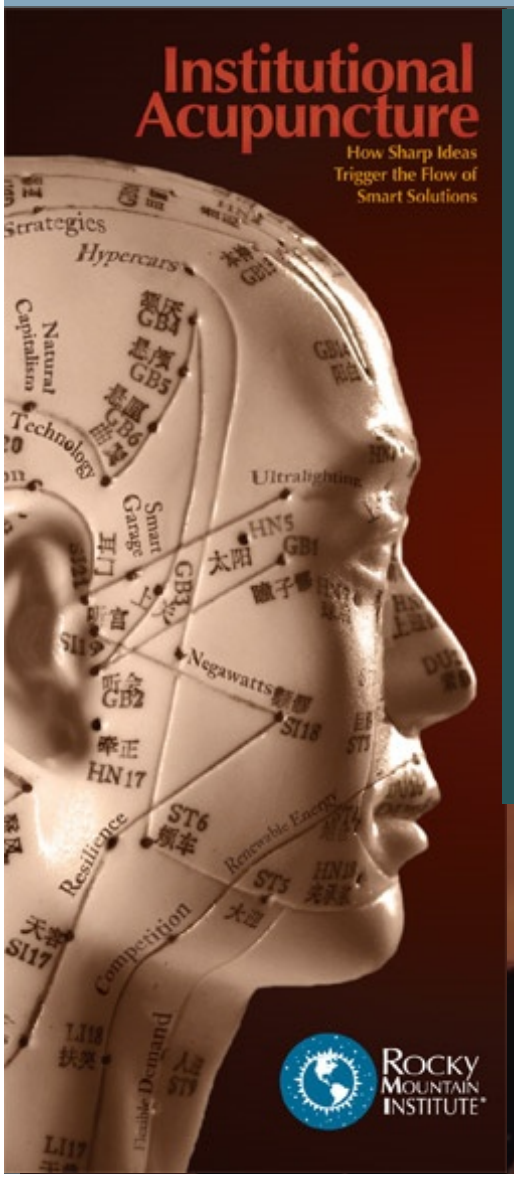
Presentation Overview

- Introductions
- Impact Potential for BEM
- DOE Strategic Plan
- BEM Innovation Summit
- BEM Critical Issues and the DOE Strategic Plan
- Q&A

RMI Mission



Rocky Mountain Institute is a nonprofit organization devoted to driving the efficient and restorative use of resources.

Our strategic focus is executed through specific initiatives that help set in motion actions that enable the dramatic reduction of US fossil fuel use.

DOE Mission

- DOE: "… ensure security & prosperity by addressing energy, environmental & nuclear challenges through transformative science & technology solutions"
- EERE: "… invest in clean energy technologies that strengthen the economy, protect the environment, and reduce dependence on foreign oil"
- BTP: "… define, develop & deploy techniques, technologies & tools to make [ed: U.S.] buildings more energy efficient, productive & affordable"

Scale of Problem

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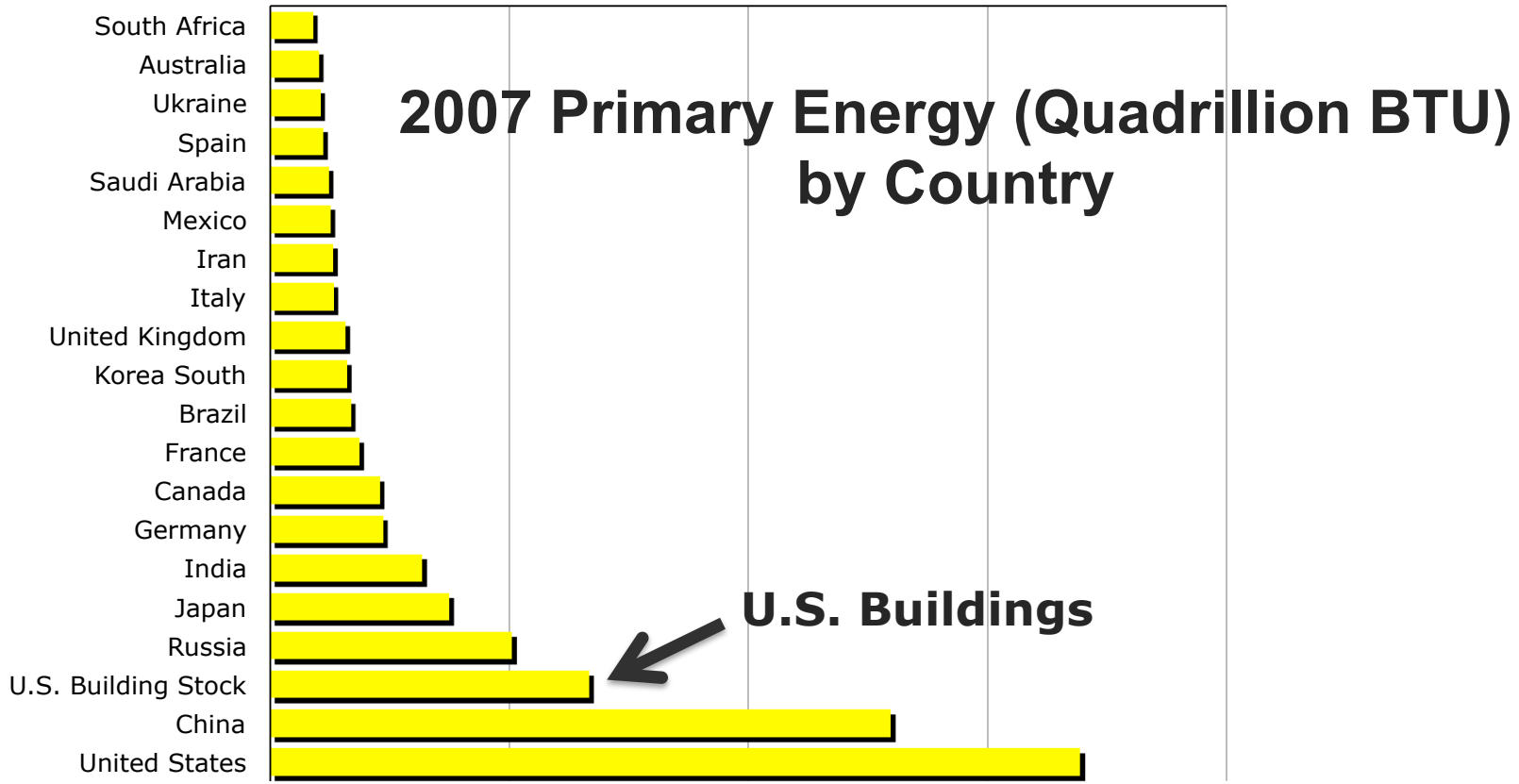

Source: Rocky Mountain Institute, 2011. Data from *International Energy Statistics*, U.S. Energy Information Administration

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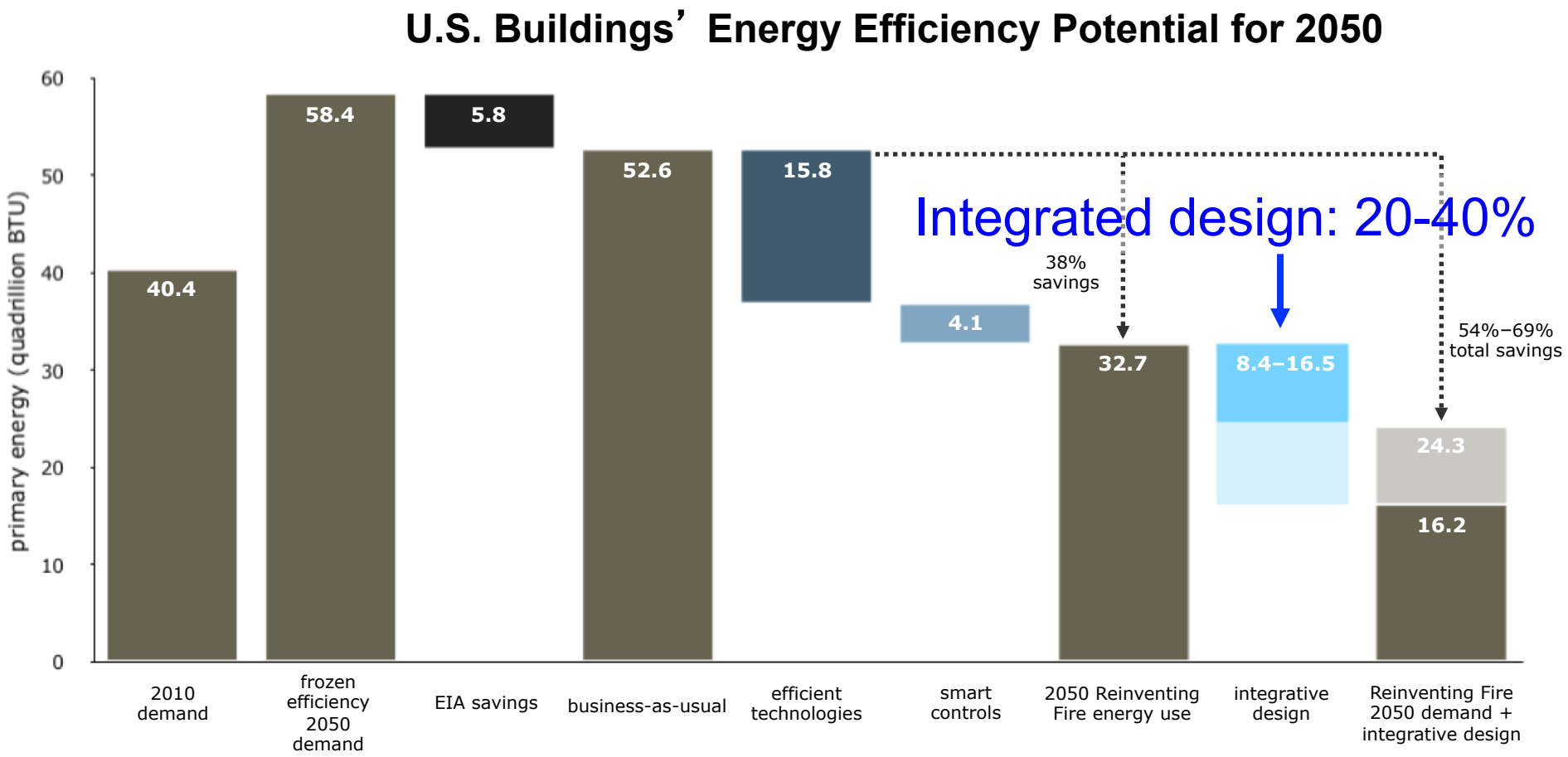
  - How much more energy efficient?
  - Is BEM one of the TT&T's required to reach this target?
  - How much should DOE DD&D BEM?

Savings Potential of BEM Integrated Design



Rocky Mountain Institute, 2011. U.S. EIA, Annual Energy Outlook 2010, May 11, 2010, http://www.eia.gov/oiaf/archive/aeo10/index.html; National Academy of Sciences. 2010. *Real Prospects for Energy Efficiency in the United States.* Washington, D.C.: The National Academies Press; Ehrhardt-Martinez, K., K.A. Donnelly, and S. Laitner. 2010. *Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*. American Council for an Energy-Efficient Economy, June.

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- AR: "… help make BEM into a tool DOE can confidently wield to meet its energy-efficiency goals"

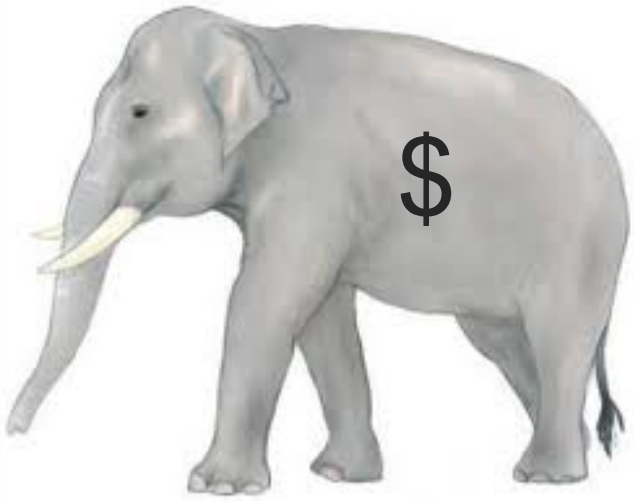
DOE's BEM Strategic Plan

- Guiding principles
  - Two-way communication
  - Active collaboration with .gov, .org, .edu, .com
  - Open standards & development platforms, easy licensing

- *Modus operandi*
  - Identify collective needs and collective capabilities
  - Connect needs with capabilities, fill in gaps
  - Embrace, push, (develop?) standards
  - Build internal capabilities, confidence & eventually programs

DOE's BEM Strategic Plan

- Targeted areas
  - Focused engine enhancements & execution speed
  - More accessible documentation & support
  - BIM interoperability, co-simulation, middlewares & toolboxes
  - Component, system, model & model output repositories
  - Cross-referenced repositories of "real" building data
  - Semi-automated model input acquisition & calibration
  - Test facilities & instrumented buildings
  - Uncertainty analysis & model validation
- Are these the right target areas for DOE
- What's the best way to execute?
- How do we ensure buy-in and uptake?



BEM Innovation Summit

Maximize the Opportunities for Modeling to Support Low-Energy Building Design and Deployment

Rocky Mountain Institute®

in partnership with

ASHRAE®

IBPSA-USA

IMT Institute for Market Transformation

U.S. Green Building Council USGBC

BEM Innovation Summit

Convene stakeholders to start a collaborative dialogue

VISION STATEMENT: *"When the energy model and the measured data disagree, the data are viewed with suspicion."*

Mike Brandemuehl – CU, Boulder

SPEAKER: *"This is going to be a game-changing event for the industry."*

Lynn Bellenger – ASHRAE President

IGNITE!:"*Coopetition*"

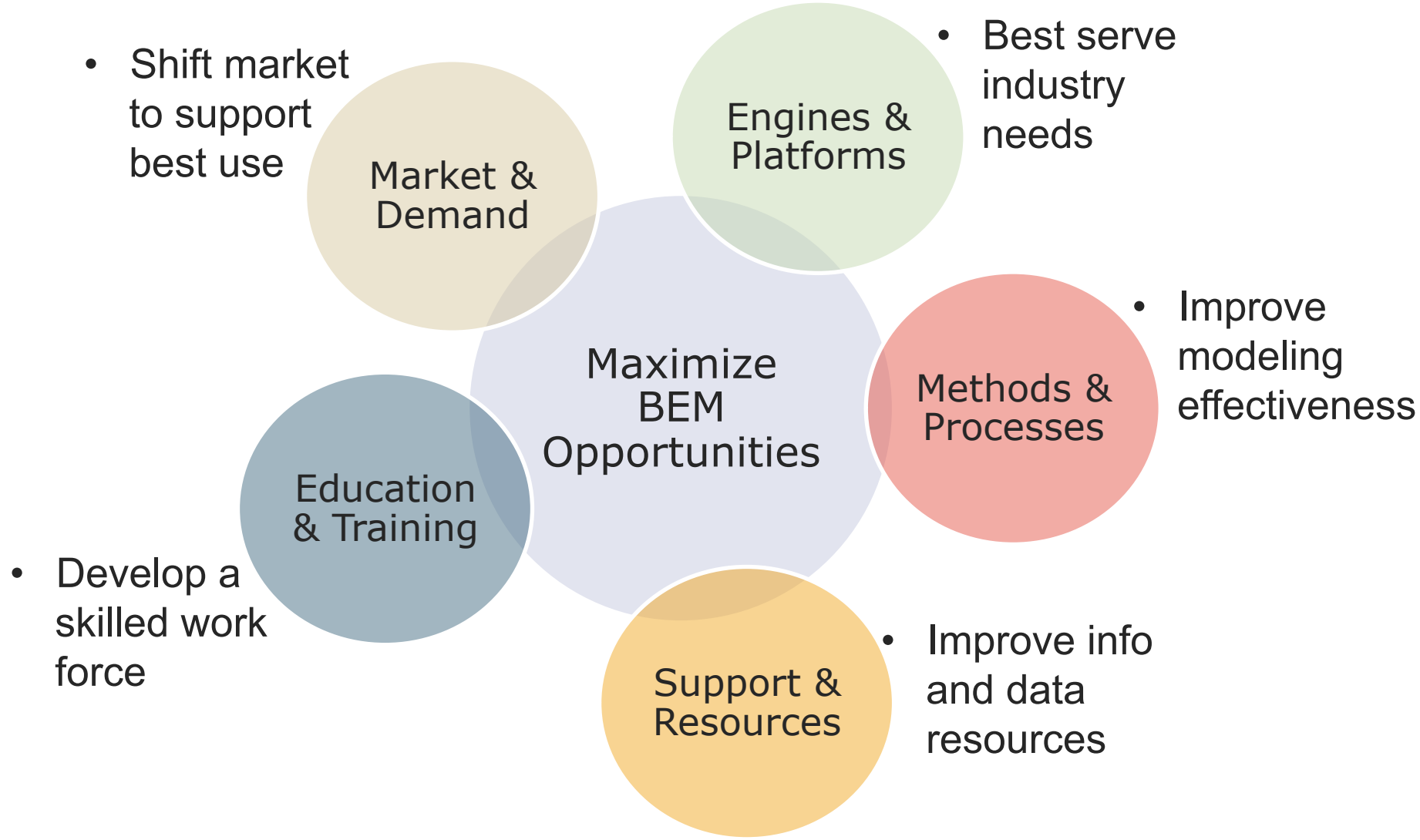
Mike Opitz – USGBC

BEM Innovation Summit
Panels and Debates

PANELS
- Practitioner and Customer Needs
- Software Developers

TALKING HEADS DEBATES
- Level of Expertise
- Level of Automation

BEM Innovation Summit
Break-Out Groups



Market Drivers & Customer Demand
Business as Usual

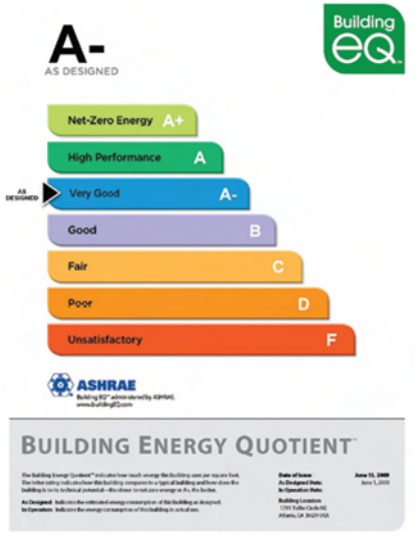
- BEM market demand experiencing steep increase
- Today's drivers do not necessarily support widespread adoption of low-energy buildings
- Damaged public perceptions of value

BEM can play a major role . . . if we get a few things right.

Market Drivers & Customer Demand Vision

- BEM used to inform broader range of decisions
- Industry develops clear value proposition for BEM
- Industry has a reputable track record with proven record

Leverage market to shift demand to support ‘best uses’ of modeling



Market Drivers & Customer Demand Work Plan

RMI Facilitator: Coreina Chan, cchan@rmi.org
Current Champion: AIA, Bill Worthen, billworthen@aia.org

Item	Description	Timeline
Steering Committee	Organize group of industry stakeholders to uphold vision	< 6 months
Assess market	Perform market potential study for energy efficiency opportunities	< 1 year
Market research	Develop branding strategy for target audiences	TBD
Case studies	Assemble collection of successful BEM case studies	TBD

Market Drivers & Customer Demand
DOE BTP Initiatives

What BTP efforts support informing and directing the expansion of BEM applications?

- Supply first: make BEM tools more friendly, robust & credible
- Then demand: performance based codes & ratings
- For now “demand”: back-office BEM for prescriptive front-ends

Are case studies being developed to promote the business case for BEM?

- NREL RSF is a great success story
- DOE will promote any and all similar stories
- GSA, FEMP, NASA, etc. may be good sources
- Need success stories for deep retrofits

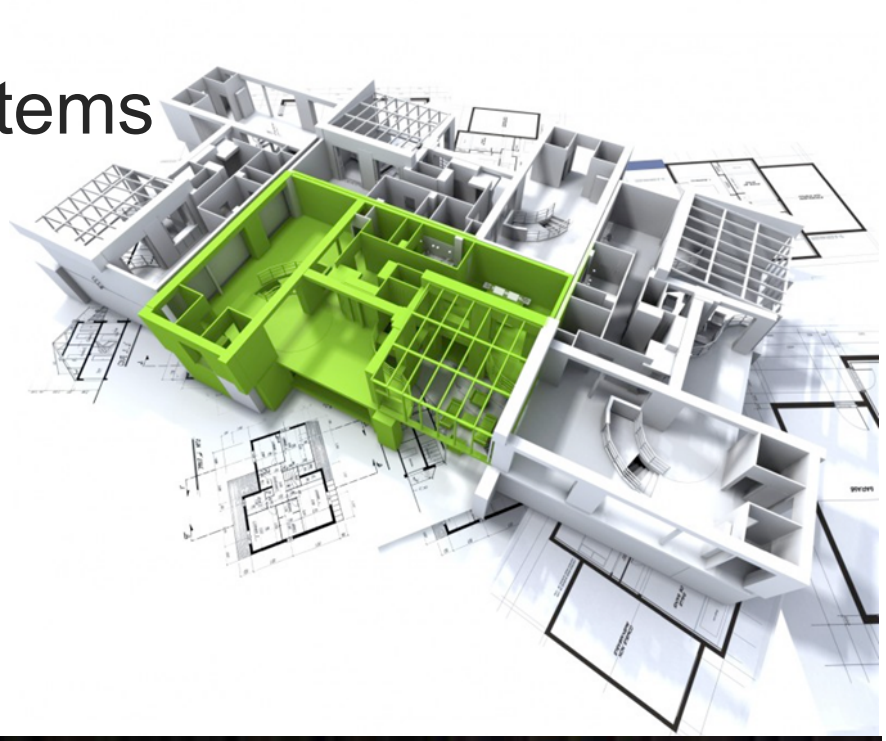
Simulation Engines and Platforms Business as Usual

- Tool deficiencies result in:
  - Steep learning curve
  - Extensive input pre-processing
  - Redundant modeling efforts and work-arounds
- Many competing platforms that lack compatibility makes shared development challenging

Practitioners use tools they are most familiar with due to lack of transparency

Simulation Engines and Platforms Vision

- Ability to model complex systems
- Increased credibility through validation
- Transparency
- Flexible
- Scalable
- Extensible



Help users design and operate buildings better

Simulation Engines and Platforms Work Plan

RMI Facilitator: Victor Olgyay, volgyay@rmi.org
Current Champion: IBPSA-USA, Tim McDowell, mcdowell@tess-inc.com

Item	Description	Timeline
Collaboration	Form venue for developers to coordinate efforts (IBPSA-USA)	Underway
Support Summit groups	Support needs of other groups/ stakeholders – e.g. markets, methods & processes	Ongoing
Support ASHRAE	Support the automation of standardized processes	Ongoing
Maximize resources	Seek DOE support of generic, long-term needs – e.g. algorithm development, lab testing, field-data gathering for validation	Ongoing

Simulation Engines and Platforms DOE BTP Initiatives

Is DOE's involvement in tool development still driven by a need to help the industry meet established performance goals?

- Started in *engine* development, end-user tools more recent
- State-of-the-art simulation engine is main focus (who else will step up?)
- Goal is to make engine capabilities easier to use

Will DOE invest in generic, big-ticket efforts that can be applied across products, such as new algorithms, inter-operability, field testing?

- Most DOE investment goes towards efforts like these
  - Equation-based modeling
  - Inter-operability & co-simulation
  - Testing & validation using instrumented buildings & test facilities

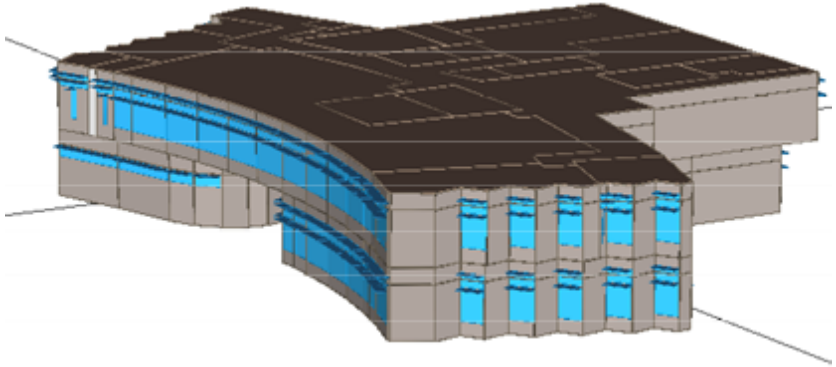
Methods & Processes
Business as Usual

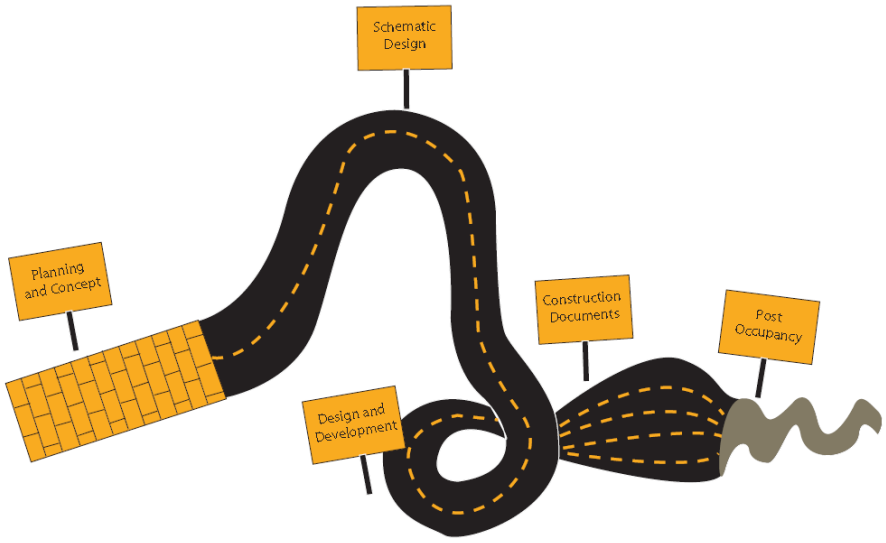
- Client expectations are often mismatched with the modeling application
- The lack of defined modeling procedures results in inconsistencies and irreproducibility
- Feedback loops are not in place to connect predicted to actual performance and inform future designs

Due to a lack of defined procedures, modelers follow a variety of processes.

Methods & Processes Opportunities Vision

- Clients understand the value and purpose of various modeling applications
- Modeling guidelines exist
- Efforts to standardize BEM process are ongoing





Methods & Processes
Vision – Methods and Processes Framework

	Design Applications		Construction Applications		Post Construction Applications	
Operating Assumptions	Standardized	Projected	Projected	Actual	Actual	Adjusted Actual
Modeling inpu data sources	Core Data Translation Methods (e.g. COMNET)					
	Method A	Method B		Method C		Method D
Quality assurance requirements	Core Quality Assurance Methods (TBD)					
	Method A	Method B		Method C		Method D

Methods and Processes Work Plan

RMI Facilitator: Ellen Franconi, efranconi@rmi.org
Current Champion: M&P Group, ASHRAE, Energy Foundation

Item	Description	Timeline
Outreach	Develop BEM customer brochure to align scope with application	CO GEO Brochure
M&P Framework	Framework to be drafted and presented to ASHRAE TC	1 month
M&P Guidelines	Informed by Framework	1 year
M&P Methods	Ongoing efforts for standardization and automation	TBD

Methods and Processes
DOE BTP Initiatives

Does the DOE plan include supporting: 1) the creation of modeling guidelines and 2) the standardization and automation of BEM processes.

- Good momentum right now at ASHRAE, COMNET
- DOE playing the role of observer
- May fund standard development involved if voids arise
- Already funding automation of standardized processes

Support & Resources
Business as Usual

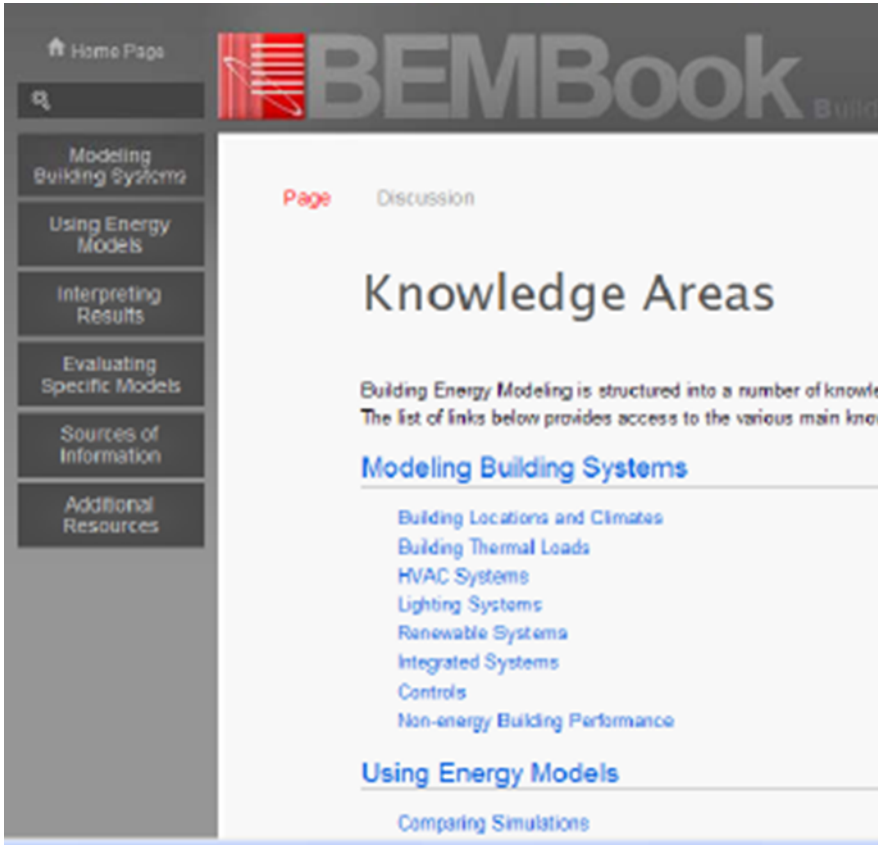
- Lack of supporting data
- Lack of compiled information resources
- Lack of data and information contributes to inconsistencies and irreproducibility

Improve modeling by improving modeling resources

Support & Resources Vision

Comprehensive, consistent and shared resources exists for:

- Benchmark data
- Probably range of input values
- Measured field data
- Manufacturer's data
- Acceptable work-arounds
- Building science and BEM knowledge



http://www.bembook.ibpsa.us

Support & Resources Work Plan

RMI Facilitator: Caroline Fluhrer, cfluhrer@rmi.org
Current Champion: NREL, Nick Long, nicholas.long@nrel.gov
IBPSA, Joe Deringer, jderinger@su-per-b.org

Item	Description	Timeline
BEM Knowledge Base	Repository of building science and BEM information	6 months – 2 years
BEM Data Base	Data base to include measured field data to inform model inputs and occupant-dependent characterizations	< 1 year
QC data	Data for checking inputs, outputs, range checking, uncertainty	6 months

Support & Resources
DOE BTP Initiatives

Does DOE have plans to fund BEM Database efforts?

- Projects currently being funded
  - Building Components Library
  - Databases of annual & fine grain data from real buildings
- Future efforts include
  - Large, public databases of models & simulation results
  - Database cross-references

Please comment on the decision not to release the CBECS 2007 data and the budget suspension for the 2011 survey?

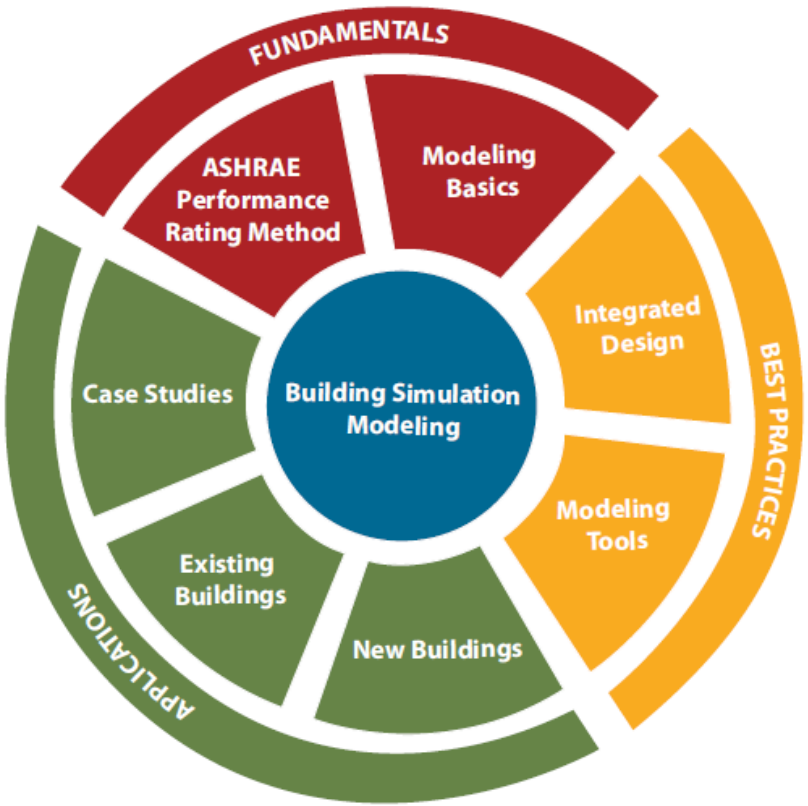
- A blow to the industry
- Some internal discussions going on but no plan

Education, Training, & Certification Business as Usual

- Lack of formalized curriculum
- Lack of comprehensive body of knowledge
- Modelers are self-taught following ad-hoc methods
- Newly offered certification programs have limited uptake

What is the best way to develop a skilled, experienced work force?

Education, Training, & Certification Vision



- Coordinated efforts are underway to develop education materials to benefit students and professionals
- System in place for discerning BEM skill levels to support on-going professional development
- Well-educated and trained modelers effectively promote low-energy buildings

Education, Training, & Certification Vision

Belt		Capabilities
Trainee	White	• Collect modeling input data
	Yellow	• Perform input data calculations
	Orange	• Develop building geometry and zoning
Tech-nician	Green	• Create building input file using software wizard
	Blue	• Build minimally-code compliant building model
Core Analyst	Purple	• Review results for reasonableness • Complete calibrations
	Brown	• Perform complex modeling • Complete detailed QC • Complete system level calibration
Master	Red	• Understand the algorithms • Use supplemental analysis
	Black	• Balance modeling level of detail against accuracy of results needed to support decision making

See “Additional Resources” at http://www.rmi.org/rmi/modelingtools

Education, Training, & Certification Work Plan

RMI Facilitator: Kendra Tupper, ktupper@rmi.org
Current Champions: AIA, Bill Worthen, billworthen@aia.org
IBPSA, Joe Deringer, jderinger@su-per-b.org

Item	Description	Timeline
Committee	Form committee to address BEM higher education needs	6 months
Support Certification	Coordinate efforts, refine exam, foster demand, develop desk reference	6 months – 2 years
Leverage Materials	Develop webinars from BEM Workshop; Contribute to IBPSA-USA BEMBook Wiki; Develop 'Black Belt' concepts	< 1 year

Education, Training, & Certification DOE BTP Initiatives

How are DOEs efforts to define job descriptions for building service professionals supporting the industry's educational needs?

- Developing "national guidelines" for 6 building service professional job categories - including energy modeling
  - Tasks, activities, knowledge, skills, abilities
- Defining final destination informs educational needs

Does DOE have plans to support BEM-specific curriculum development at the higher education level?

- Supporting creation & standardization of open knowledge base
- Not explicitly supporting "curriculum development"

DOE AND BEM SUPPORT

Item	Description	DOE
Market Drivers	• Market potential study • Business-case studies	$ ☺
Platforms and Tools	• Algorithm development • Lab and field testing • Interoperability • Wider range of users, input detail	$$ $$ $$ $
Methods & Processes	• BEM Methods Framework • BEM Guidelines • Standardization and automation	☺ ☺ $
Support & Resources	• BEM Knowledge Base • BEM Data Base • BEM QC Data	$ $$ ☺
Education & Training	• BEM curriculum development • Education for BEM service providers	☺ $

Key: Like ☺ Strategic Plan: - Funded $ - Potential Funding $

DOE and BEM Support

BEM Support Needs	DOE Strategic Plan Initiatives
• Market potential study • Business-case studies	• Booz-Allen IV&V • RSF, others?
• Algorithm development • Lab and field testing • Interoperability • Wider range of users, input detail	• Equation-based modeling • Lab test facilities, Hub buildings • BIM middleware • Many
• BEM Methods Framework • BEM Guidelines • Standardization and automation	• None yet • None yet • BIM middleware
• BEM Knowledge Base • BEM Data Base • BEM QC Data	• EnergyPlus wiki • BuildingComponentsLibrary • None yet
• BEM curriculum development • Education for BEM service providers	• None planned • Workshops and web materials

Closing

For more information about the BEM Innovation Summit and how you can get involved

http://rmi.org/rmi/ReportsBEMInnovationSummit

Thank you for attending

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